Applicants: Hamilton et al.
Serial No.: 09/560,224
Filing Date: April 28, 2000
Docket No.: ZIL-300-1P-1C

Amendments to the Specification:

Please amend the title to read:

~~Improved~~ Circuit Design and Optics System for Infrared Signal Transceivers

Please amend the paragraph beginning on page 1, line 3, as follows:

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of, and claims priority under 35 U.S.C. §120 from, nonprovisional U.S. patent application Serial No. 09/285,608, filed ~~4/2/1999~~on April 2, 1999, now ~~pending~~abandoned, the subject matter of which is incorporated herein by reference. Application Serial No. 09/285,608 is a continuation-in-part of, and claims priority under 35 U.S.C. §120 from, nonprovisional U.S. patent application serial number 09/113,036 filed on July 9, 1998, now U.S. Patent No. 6,281,999, the subject matter of which is incorporated herein by reference.

Please amend the paragraphs beginning on page 3, line 1, and ending on page 3, line 18, as follows:

Figure 1 depicts the typical infrared data communications hardware that is installed in electronic devices; it is a perspective view of a prior infrared transceiver assembly 10. As discussed above, these assemblies 10 are found in virtually every notebook computer sold today. The components of the assembly 10 are virtually identical across all manufacturers' product lines, with few exceptions. The typical assembly 10 comprises a housing 12 within which the infrared ~~infrared~~ emitting device and infrared detection device (see

Figure 2) are mounted. The "transceiver" is actually data processing circuitry for managing the infrared emitting device and infrared detection device; ~~it's~~its location is therefore not optically-dependent (and, in fact, it operates better in "IR darkness"). The housing 12 usually is molded from plastic, with a primary lens unit 14 formed in one of the sides of the housing 12. As can be seen, the conventional primary lens unit 14 comprises two lenses; one each for the infrared emitting device and infrared detection device (both lenses with similar optical properties. and both requiring precision and reproducibility). Adjacent to the housing 12, is a protective lens 16. The protective lens 16 is generally constructed from a colored plastic that is transparent to infrared signals. In most cases, the protective lens 16 is attached to the external case of the electronic device, its purpose being to protect the inner workings of the device, while also permitting infrared signals to pass in and out. Figure 3 gives further detail regarding the workings of the prior assembly 10.

Please amend the paragraphs beginning on page 4, line 6, and ending on page 4, line 12, as follows:

The infrared emitting device and infrared detection device pair 20 transmit and receive infrared signals. The infrared emitting device and infrared detection device pair 20 is typically mounted to a stand 22, and thereby positioned in the signal path of the primary lens 14 in order to send and receive infrared signals therethrough. As discussed earlier, the appliance case 24 has an aperture 25 formed therein, and into which a protective lens 16 is installed. The protective lens 16 simply protects the inner workings of the appliance from contamination.

Please amend the paragraphs beginning on page 4, line 18, and ending on page 5, line 11, as follows:

Second, the primary lens unit 14 mandates higher manufacturing and design
standards than the average plastic housing for an electronic device to insure that the light-refractive traits of the primary lens 14 are predictable and repeatable. Because the primary lens unit 14 is integral to the housing 12, the entire housing 12 becomes subject to the elevated quality standards. It would be much more cost-effective if the design of the integral primary lens unit 14 did not mandate elevated quality standards for the entire housing 12.

Other defects with the prior assembly 10 are ~~illuminated~~ illustrated by Figure 3. Figure 3 is a cutaway side view of the transceiver assembly 10 of Figures 1 and 2, depicting the typical transmit dispersion angle Θ_T of the assembly 10. By current IrDA (Infrared Data Association) standards, the transmit dispersion angle Θ_T must be at least 15 (fifteen) degrees from the focal axis 26 (in two dimensions, of course). The transmit dispersion angle Θ_T is the sum-total of the primary lens refraction angle Θ_1 and the protective lens refraction angle Θ_2. All prior assemblies 10 include a protective lens 16 that has no refractive power; the protective lens 10 refraction angle Θ_2 is, therefore, typically 0 degrees. Consequently, the conventional primary lens unit refraction angle Θ_1 is 15 (fifteen) degrees.

Please amend the paragraphs beginning on page 6, line 7, and ending on page 7, line 9, as follows:

Another problem exists in regard to the conventional design for ~~Ir~~ infrared transceiver assemblies. As can be seen from Figure 9, which depicts

the ~~Ir~~ infrared transceiver assembly 10 of Figures 1 and 2, the ~~Ir~~ infrared transceiver assembly 10 comprises a housing 12 within which is found a PC board 18. It is understood that the PC board in some cases might be replaced with a lead frame. The PC board generally has a front side 68 and a back side 70; the housing 12 is typically formed with ~~a~~ an infrared detection device lens element 14A and an infrared emitting device lens element 14B (which together comprise primary lens element 14 described above in connection with Figure 1). Mounted on the PC board 18 and in the optical path of the infrared detection device lens element 14A is a conventional~~ly~~ infrared detection device 64. Also mounted on the PC board 18, and in the optical path of the infrared emitting device lens element 14B, is ~~generally found~~ an infrared emitting device 62. Transceiver circuit device 72, which is typically an integrated circuit device comprising hardware which can send and receive signals from the infrared emitting device 62 and the infrared detection device 64, respectively, is also attached to the PC board 18, (geographically located between the infrared detection device 64 and the infrared emitting device 62). For the PC board 18 situation, transceiver circuit device 72, infrared detection device 64 and infrared emitting device 62 are electrically connected to the pc board 18 via connection means 74 which in this case is of the wire bond type conventionally known in the field. ~~The~~ A problem with ~~the~~ conventional ~~Ir~~ infrared transceiver ~~assembly~~ assemblies 10 is ~~one of~~ real estate. In the package shown in Figure 9, the requirement for separate footprints for the infrared emitting device 62, the infrared detection device 64 and the transceiver circuit device 72, mandates that the PC board 18 is wide and further mandates that there be a plurality of lens elements. It would be beneficial if this large combination of footprints could be minimized by reducing the device size of the transceiver assembly and potentially the cost, among other advantages.

Please amend the paragraphs beginning on page 8, line 2, and ending on page 8, line 15, as follows:

In light of the aforementioned problems associated with the prior devices, it is an object of the present invention to provide an ~~Improved~~ improved ~~Circuit~~ circuit ~~Design~~ design and ~~Optics~~ optics ~~System~~ system for ~~Infrared~~ infrared ~~Signal~~ signal ~~Transceivers~~transceivers. It is a further object that the improved system include an ~~IR~~ infrared transceiver assembly that is easily grasped by assemblers. It is also an object that the primary and secondary lenses associated with the transceiver system be easier to manufacture than current lens designs. It is a still further object that the heretofore critical lens separation between the infrared emitting and infrared detection devices and the primary lens become a flexible dimension, dependent only upon the particular appliance in which the system is installed. It is another object that the stand for infrared emitting and infrared detection devices be eliminated as a result of exchanging a non-imaging transceiver system with the current imaging transceiver system. Finally, it is an object that infrared emitting and infrared detection devices be assembled or otherwise combined into a single infrared emitting/infrared detection device stack. A further object of the present invention is to provide an~~d~~ improved ~~the~~ ~~Ir~~ infrared transceiver assembly that has much smaller outside dimensions than the current state of the art.

Please amend the paragraphs beginning on page 9, line 2, and ending on page 10, line 15, as follows:

The objects and features of the present invention~~, which are believed to be novel,~~ are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with

further objects and advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawings, ~~of which~~wherein:

Figure 1 (prior art) is a perspective view of a prior art infrared transceiver assembly;

Figure 2 (prior art) is a cutaway side view of the prior art infrared transceiver assembly of Figure 1;

Figure 3 is a cutaway side view of the transceiver assembly of Figures 1 and 2, depicting the typical transmit dispersion angle;

Figure 4 is a cutaway side view of a preferred embodiment of the improved transceiver assembly of the present invention;

Figure 5 is a cutaway side view of another preferred embodiment of the improved transceiver assembly of the present invention;

Figure 6 is a partial cutaway side view of yet another preferred feature of the improved transceiver assembly of the present invention;

Figure 7 is a partial perspective view of still another preferred embodiment of the present invention;

Figure 8 is a partial cutaway side view of an integrated infrared emitting infrared detection device stack of the present invention;

Figure 9 (prior art) is a cutaway top view of ~~the~~ a conventional ~~Ir~~ infrared transceiver assembly depicted in Figure 1;

Figure 10 is a cutaway top view of the improved ~~Ir~~ infrared transceiver assembly of the present invention depicting a backside-mounted transceiver circuit device;

Figure 11 is a cutaway top view of another improved ~~Ir~~ infrared transceiver assembly depicting another backside-mounted transceiver circuit device~~9~~;

Figure 12 is a cutaway top view of yet another improved ~~Ir~~ infrared transceiver assembly depicting an integrated infrared emitting infrared detection device and a backside mounted transceiver circuit device;

Figure 13 is a cutaway top view of another improved ~~Ir~~ infrared transceiver assembly also employing the integrated infrared emitting infrared detection device of the present invention and another example of a backside-mounted transceiver circuit device; and

Figure 14 is a cutaway top view of still another improved ~~Ir~~ infrared transceiver assembly using a front side-mounted transceiver/infrared emitting infrared detection device stack.

Please amend the paragraphs beginning on page 14, line 3, and ending on page 14, line 7, as follows:

It is also possible that a secondary lens employing shiftable and/or variable refracting regions is currently available, such as via Liquid Crystal technology. Furthermore, the secondary lens might be configured to mask out certain regions by being selectively opaque to infrared signal transmission. Each of these features is ~~an~~ a significant advancement over the prior devices.

Please replace the paragraphs beginning on page 14, line 20 and ending on page 18, line 3 with the following replacement paragraphs:

Now turning to Figure 10, we can take a look at another embodiment of the present invention. Figure 10 is a cutaway top view of the improved ~~Ir~~ infrared transceiver assembly 76 of the present invention depicting a backside-mounted transceiver circuit device 72. Similar to Figure 9, the device of Figure 10 has a PC board ~~10~~ 18 having a front side 68 and a backside 70. Also, this transceiver assembly 76 includes ~~a~~ an infrared detection device lens element 14A and an infrared emitting device lens

element 14B located to the front side 68 of the PC board ~~68~~ 18 and electrically connected through connection means 74. What is unique about this present embodiment is that the transceiver circuit device 72 is actually located on the backside 70 of the PC board ~~70~~18. In this case, the transceiver circuit device 72 is electrically connected to the PC board 18 via alternate connection means 78, which in this case comprises "bump" attachment (a common device soldering method). As can be seen from 10 the improved assembly 76 of Figure 10, since the transceiver circuit device 72 is no longer located between the infrared detection device lens element 14A and the infrared emitting device lens element 14B, the width of ~~pc~~ PC board 18 and therefore the size of the housing 12 is much narrower, allowing the assembly 76 to be much smaller in size.

If we now turn to Figure 11, we can see yet another embodiment of an improved ~~Ir~~ infrared transceiver assembly 80. Figure 11 is a cutaway top view of another improved ~~Ir~~ infrared transceiver assembly depicting another backside-mounted transceiver circuit device 72. In Figure 11, the base structure is a lead frame 82. A lead frame, like the PC board of the previous figures, is a common device mounting structure in the semi-conductor and electronics industry. The lead frame 82 has a back side 84 and a front side 86, just as with the PC board 18. In the transceiver assembly 80 of this preferred embodiment, the infrared detection device 64 and infrared emitting device 62 are both attached to the front side of the lead frame 86, however in this case, the transceiver circuit device 72 is attached to the backside of the lead frame 84, through the conventional connection means 74, comprising typical wire bond interconnection for electrical conductance. Just as with assembly 76 in Figure 10, this embodiment 80 provides the advantage of a reduced package size, as well as providing at least two mounting and connection options for the transceiver circuit device 72.

Figure 12 depicts yet another improved ~~Ir~~ infrared transceiver assembly 88 of the present invention. Figure 12 is a cutaway top view of yet another improved infrared~~Ir~~ transceiver assembly 88 depicting an integrated infrared emitting/infrared detection device stack 66 and a backside-mounted transceiver circuit device 72. In this embodiment, the integrated infrared emitting/infrared detection device stack 66 is employed on the front side of the PC board 68 and connected thereto via connection means 74. Since the infrared emitting/infrared detection device stack 66 is integrated, the need for two lens elements is eliminated, resulting in a single primary lens element 14C. Furthermore, the transceiver circuit device 72 is attached to the backside of the PC board 70, just as described above in connection with Figure 10. As can be appreciated, this preferred embodiment of the transceiver assembly 88 provides even further package size reduction over the previous units.

Similarly, Figure 13 depicts the integrated infrared emitting/infrared detection device stack 66 attached to the lead frame's front side 86 with the transceiver circuit device 72 being attached to the backside of the lead frame 84. Figure 13 is a cutaway top view of another improved ~~Ir~~ infrared transceiver assembly 89 also employing the integrated infrared emitting/infrared detection device stack 66 of the present invention and another example of a backside-mounted transceiver circuit device 72. Again, like the assembly 88 of Figure 12, this present embodiment of an improved ~~Ir~~ infrared transceiver assembly 89 provides significant benefits in package size reduction.

Finally, we will turn to Figure 14 to examine yet another preferred embodiment of an improved ~~Ir~~ infrared transceiver assembly 90. Figure 14 is a cutaway top view of still another improved ~~Ir~~ infrared transceiver assembly 90 having a front side-mounted transceiver/infrared emitting/infrared detection device stack. This assembly 90 provides the smallest package size yet. In

this case, the integrated infrared emitting/infrared detection device stack 66 and the transceiver circuit device 72 are stacked together in a transceiver/infrared emitting/infrared detection device stack 96. Since the infrared emitting/infrared detection device stack 66 and the transceiver circuit device 72 are stacked, all devices can be attached to the front side of the circuit structure 94. As can be appreciated, the circuit structure 92 might comprise a ~~pc~~ PC board or a lead frame or other conventional structural circuit-providing devices conventional in the art. It should be understood from this view that since all of the devices are attached to the front side of the circuit structure 94, the housing 12 is not only reduced in width, but is also thinner in depth than those improvements previously described in connection with Figures 10 through 13. In other embodiments, there might be multiple infrared emitting/infrared detection device stacks 66 spread out over the face of a single transceiver circuit device 72, which is then attached to the front side of the circuit structure 94. Furthermore, and as discussed previously in connection with Figures 3 through 8, while a single primary lens element 14C is shown here, this improved ~~Ir~~ infrared transceiver assembly 90 might also include an embodiment where there is a primary lens element 14C as well as a secondary lens element 40. Still further, the embodiment is conceived where in a single device, the transceiver circuitry as well as the infrared emitting device and infrared detection device circuitry are combined such that a single set of connection means 74 attaches this integrated device to the circuit structure front side 94.